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Setting and First Season Survival of the American Oyster Crassostrea virginica Near Oxford, Maryland 1961-62

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J. R. WEBSTER and W. N. SHAW

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Setting and First Season Survival of the American Oyster, Crassostrea virginica, Near Oxford, Maryland, 1961-62

By

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ABSTRACT

The setting of oysters in Broad Creek and Tred Avon River, on the eastern shore of Chesapeake Bay, was monitored during 1961 and 1962. Setting was substantially greater both years in Broad Creek, and the highest number of spat were found on shells suspended from 0.3 to 9 meters below the surface. Three times more spat were caught on shells in bags than on shells broadcast on the bottom.

In Tred Avon River setting was very light in 1961 and light in 1962, except during the week of 30 July to 6 August. In Broad Creek setting was heaviest during the week of 17 to 24 July 1961 and during each week from 25 June to 13 August 1962.

First-season survival rates were 1 to 27 percent. There was some indication, especially in Broad Creek during 1962, that the greater the setting rates the lower the first-season survival rates.

INTRODUCTION

The Tred Avon River and Broad Creek are tributaries of the lower Choptank River on the eastern shore of Chesapeake Bay, Talbot County, Md. Both waterways receive relatively small amounts of fresh-water drainage and are characterized by similar salinities ranging from 8 to 16 p.p.t. (parts per thousand) and temperatures fluctuating from 0° to about 30° C. Each has natural oyster grounds that are tonged commercially from September to April. Past surveys have shown the Tred Avon River to be low or erratic in oyster setting (Beaven, 1954). In contrast, oyster setting in Broad Creek has been high enough to justify shell planting on a small reservation of bottom (2.0 to 2.8 hectares) by the Maryland Department of Chesapeake Bay Affairs in a program of annual oyster propagation.

In 1961 the Bureau of Commercial Fisheries Biological Laboratory, newly located near the mouth of the Tred Avon River, at Oxford, Md., began studying the oyster-setting potential of adjacent waters. These studies included estimates of oyster setting rates and survival in the Tred Avon River and Broad Creek. The information obtained could be used in planning specific projects of research related to or dependent upon setting potential.

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METHODS

Oyster shells (cultch), obtained from a local shucking house, were placed in bags of 2.54 cm. mesh galvanized poultry wire. (New bags were kept submerged for several weeks before adding oyster shells, to oxidize the galvanized wire and reduce active ionization which might deter setting.) The shell contents (8.8 liters or about 90 shells) of each bag formed a mass about 23.1 cm. high, 38.5 cm. wide, and 12.8 cm. thick. In this report, bags put in the water for 7 days and then replaced are called weekly bags and those which remained in place throughout the setting season, 20 June to 3 October 1961 and 18 June to 10 September 1962, are called seasonal bags.

Ten stations were established in 1961 at intervals along 13 km. of the Tred Avon River, from near the headwaters to near the mouth, in water depths of 2.2 to 2.4 m. Four stations in Broad Creek were at similar water depths (fig. 1). Two seasonal bags and single weekly bags were placed just touching bottom at stations 1 to 9 in the Tred Avon River and at stations 1 to 3 in Broad Creek.

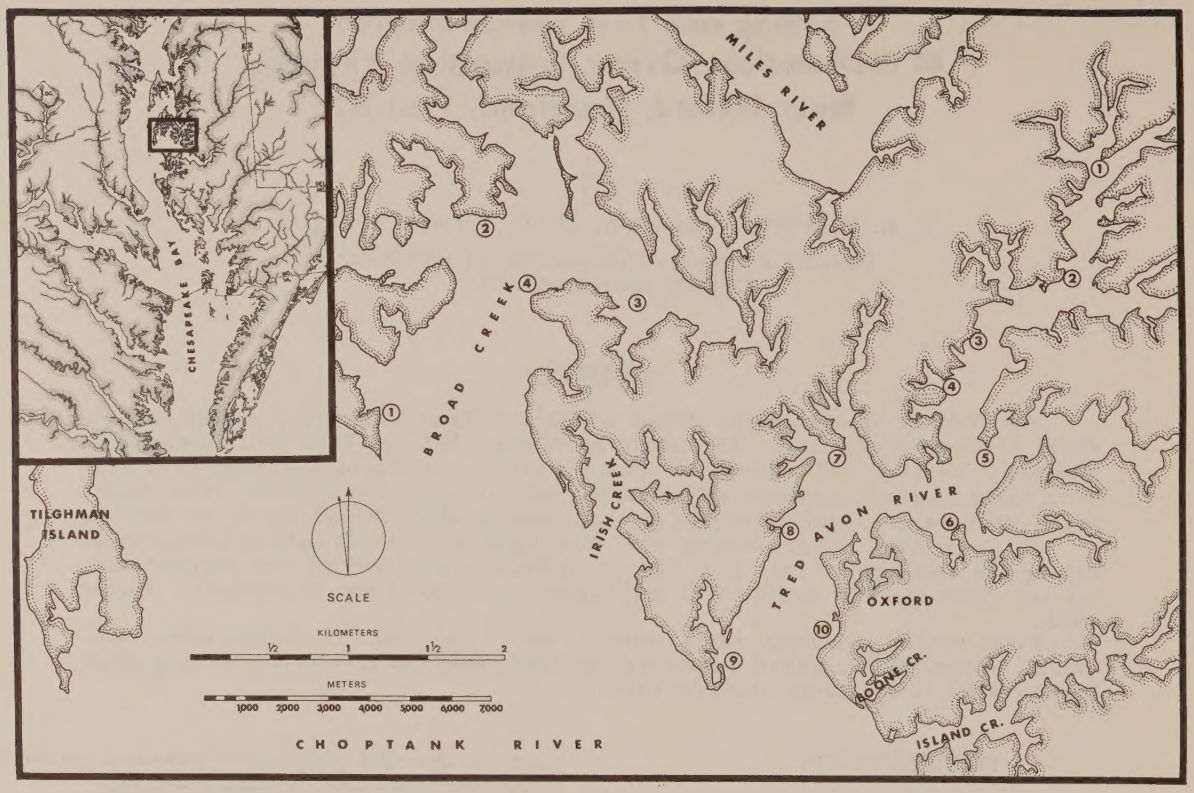

Figure 1.--Collecting stations in the Tred Avon River and Broad Creek, Md., 1961-62.

At station 10 in the Tred Avon River and at station 4 in Broad Creek three rows of seasonal bags and a single row of weekly bags were attached to chains. There were six bags in each row--one at every 0.3-m. vertical interval of the water column (fig. 2). Depth 1 extended from the bottom to 0.3 m. off bottom; depth 2 was 0.6 m. off bottom, ... depth 6, 1.8 m. off bottom.

Identical bags and similar placement methods were used in 1962. Because of the general lack of oyster setting in the Tred Avon River in 1961, the number of stations was reduced to five in 1962 (stations 2, 4, 5, 7, and 9 were abandoned). Setting in various depths at station 10 was not investigated. Station locations and off-bottom arrangements in Broad Creek remained as in 1961.

Oyster setting in weekly bags was estimated by examining the inner faces of 20 average-size cultch shells (76-127 mm. long) taken at random from each bag. Spat and spat scars (the attached lower shells or fragments of lower shells with their upper shells missing) were counted under 20X magnification. It was assumed that: (1) the weekly counts would reveal the time of setting, and (2) the total of such counts at each station for the season would approach the maximum possible set for the setting period. The total spat yield per seasonal bag was determined by counting spat on both shell faces of all shells in a bag, but only counts on the inner faces were used in estimating survival rates, since this was the only surface examined in the weekly shell bags.

Survival rates were estimated as follows: The total number of spat on the inner faces of all shells in each seasonal bag was reduced to an average per 20 inner shell faces. Next, an average of the duplicate or triplicate seasonal bags per 20 inner shell faces at each station and depth was derived. Percentage of survival was then calculated by dividing the average count per 20 shell faces on the seasonal bags X 100 by the accumulated counts of spat per 20 shell faces on the weekly bags. For example: In 1961, Broad Creek, station 1, depth 0.3 m. off bottom, the average count of spat per 20 shell faces of the duplicate seasonal bags was 20.9. At this same station the total count of setting per 20 shell faces in all weekly bags was 92 spat. Finally, 20.9 X 100 divided by 92 gives 23 percent.

Oyster setting in bagged shells was compared with setting on shell cultch broadcast loosely on the bottom; the latter procedure is commonly practiced in Maryland. A bottom plot about 30.5 m. by 4.6 m. beside

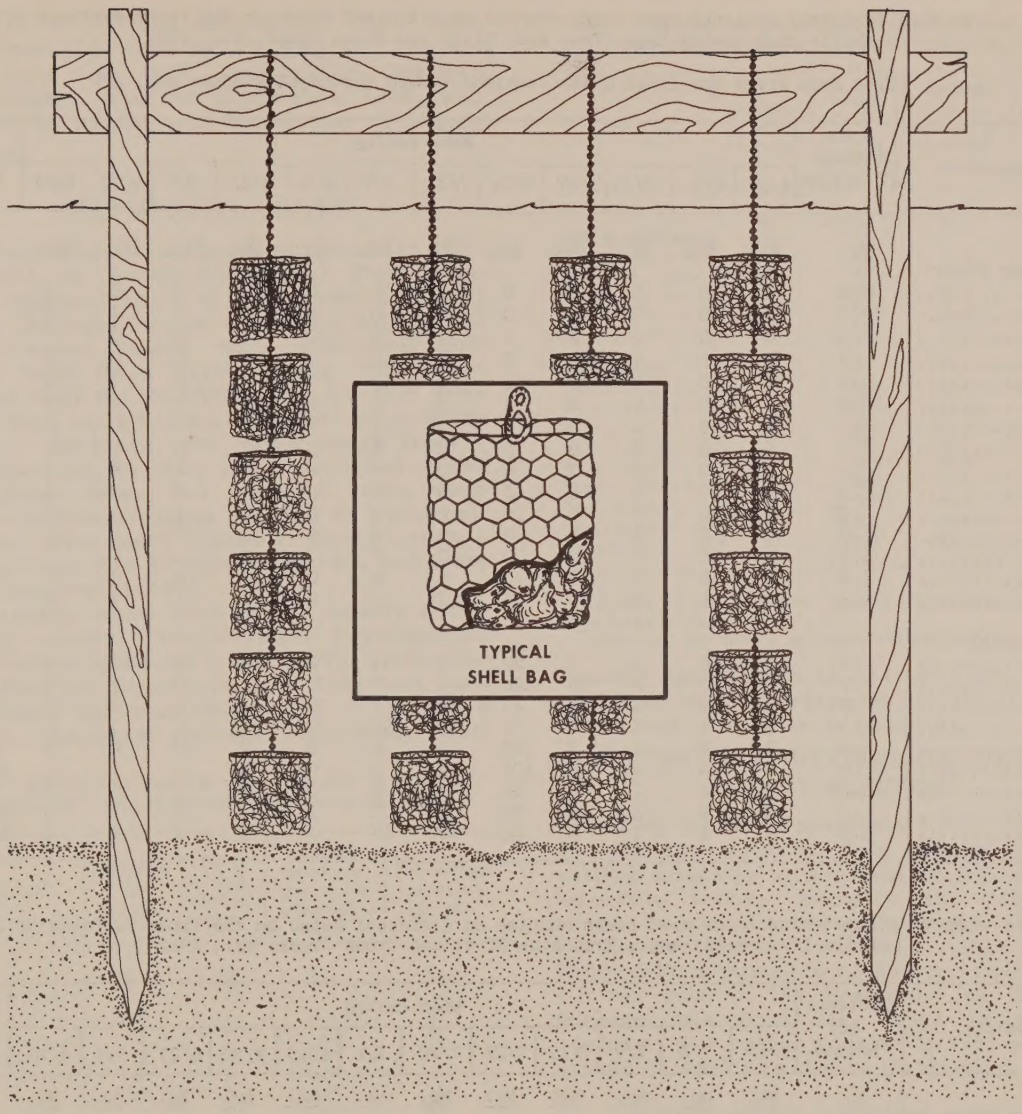

Figure 2.--Suspension of spat collecting bags from chains to occupy different depths of the water column.

station 10 (fig. 1) in the Tred Avon River was dredged clear of oyster shells. When stations were established and bags put out, the plot was covered evenly with 3,524 liters of shells from the same source as those in the bags. Five pairs of seasonal bags were spaced evenly along the longer center line of the plot. When the bags were removed from the plot at the end of the season, 10 equivalent volumes of loose bottom shells were tonged from the area near the paired bags. Spat counts on the two groups were compared.

THE WEEKLY SETTING OF OYSTERS IN 1961 and 1962

Data from spat counts on weekly bags indicated that conditions affecting oyster setting in the Tred Avon River and Broad Creek were different in 1961 and 1962. The set was very light and sporadic in the Tred Avon River in 1961, but in 1962 the set was heavy during the week of 30 July to 6 August (tables 1 and 2). Setting was much heavier in Broad Creek than in Tred Avon River in both 1961 and 1962. A peak occurred in 1961 between 17 July and

Table 1.--Numbers of oyster spat and spat scars counted on different dates on the inner surfaces of 20 shells from weekly bags, Tred Avon River and Broad Creek, Md., 1961

(Tred Avon River and Broad Creek stations tended fortnightly after Aug. 22)

Station	Distance off bottom	Week ending												Season total
		6/27	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/22	9/5	9/18	10/3	
	M.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Tred Avon River:														
1	0.3	0	0	0	1	0	1	0	0	0	0	0	2	4
2	.3	1	0	0	2	3	0	0	0	0	0	1	0	7
3	.3	0	0	0	2	1	4	0	0	2	0	0	0	9
4	.3	0	0	1	2	0	0	0	1	0	0	0	2	6
5	.3	2	0	0	0	2	1	3	1	0	0	5	0	14
6	.3	0	0	0	0	1	1	0	2	0	0	4	0	8
7	.3	1	0	0	1	2	5	1	1	0	0	10	0	21
8	.3	0	0	0	0	0	0	0	0	0	0	0	0	0
9	.3	1	0	0	3	0	0	0	0	1	1	4	1	11
10	.3	1	0	0	0	0	0	0	2	0	1	3	0	7
10	.6	0	0	0	0	0	0	0	0	0	1	1	0	2
10	.9	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1.2	1	0	0	0	0	0	0	1	1	1	0	0	4
10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1.8	0	0	0	0	1	0	0	0	0	1	1	0	3
Broad Creek:														
1	.3	0	0	4	2	52	9	11	2	0	1	11	0	92
2	.3	0	3	2	24	126	2	5	0	0	0	7	0	169
3	.3	1	2	1	52	31	1	7	0	1	4	3	0	103
4	.3	0	6	1	1	6	1	10	0	1	0	1	0	27
4	.6	3	2	1	2	50	1	9	0	0	0	0	0	68
4	.9	0	14	4	8	103	2	3	0	0	1	2	0	137
4	1.2	0	4	2	16	38	1	6	5	2	0	2	0	76
4	1.5	0	2	2	6	82	2	7	2	0	0	4	0	107
4	1.8	1	2	1	4	86	12	10	2	1	1	1	0	121

Table 2.--Numbers of oyster spat and spat scars counted on different dates on the inner surfaces of 20 shells from weekly bags, Tred Avon River and Broad Creek, Md., 1962

Station	Distance off bottom	Week Ending											Season total
		6/25	7/2	7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/4	9/10	
	M.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Tred Avon River:														
1	0.3	0	1	0	37	2	5	47	16	0	3	1	0	112
3	.3	0	0	0	27	6	50	141	37	0	0	1	1	263
6	.3	0	0	0	2	4	48	724	33	4	1	3	2	821
8	.3	0	0	0	0	0	22	380	37	3	0	1	0	443
10	.3	-	0	0	0	1	13	77	9	5	0	1	0	106
Broad Creek:														
1	.3	-	76	7	16	132	56	150	185	1	1	0	0	624
2	.3	-	553	79	27	361	108	126	129	1	2	5	1	1392
3	.3	-	134	([1])	67	160	135	71	197	4	0	3	0	771
4	.3	-	45	2	11	106	120	41	356	3	1	0	5	690
4	.6	-	100	14	15	181	49	41	100	1	1	0	1	503
4	.9	-	248	16	11	162	93	140	134	0	0	2	2	808
4	1.2	-	158	11	29	282	142	129	266	2	1	3	2	1025
4	1.5	-	328	63	38	298	200	123	205	3	1	0	3	1262
4	1.8	-	580	26	162	613	306	84	322	0	1	0	2	2096

[1] Bag lost.

24 July, but in 1962 setting was heavy each week from 25 June to 13 August. The set was light in both tributaries between 5 September and 18 September 1961, and little or no setting was found after 13 August 1962.

SPAT SURVIVAL RATE

The calculated spat survival rates for 1961 and 1962 in Broad Creek and Tred Avon River ranged from 1 to 75 percent (tables 3 and 4). Because counts of weekly setting and end-of-season counts were extremely low in the Tred Avon River during 1961, it is doubtful that the survival rate for that year in that area is of any significance. When these data are excluded, the rates range from 1 to 27 percent. In 1962 a set occurred in the Tred Avon River, but survival rates were extremely low--ranging from 1 to 2 percent. Survival rates were higher in Broad Creek--ranging from 8 to 27 percent in 1961 and from 1 to 20 percent in 1962.

Generally, when total set on weekly shells was high, survival rates were low. For example, total weekly counts of 1,392, 2,096, 1,262, and 1,025 spat in Broad Creek in 1962 had corresponding survival rates of 8, 1, 3, and 6 percent, whereas stations with lower total weekly spat counts of 624, 771, 808, 503, and 690 had survival rates of 18, 14, 10, 20, and 9 percent, respectively (table 4).

Table 3.--Setting and survival of oyster spat by station and depth, Tred Avon River and Broad Creek, Md., 1961

Station	Distance off bottom	Total of all weekly counts[1]	Average count on shells in seasonal bags[2]	Percentage survival of spat
	M.	No.	No.	No.
Tred Avon River:				
1	0.3	4	0.4	10
2	.3	7	.9	13
3	.3	9	2.2	24
4	.3	6	2.6	43
5	.3	14	1.8	13
6	.3	8	.9	11
7	.3	21	2.0	10
8	.3	0	1.0	--
9	.3	11	2.0	18
10	.3	7	.9	13
10	.6	2	1.5	75
10	.9	0	.5	--
10	1.2	4	.7	18
10	1.5	0	.6	--
10	1.8	3	.4	13
Broad Creek:				
1	.3	92	20.9	23
2	.3	169	29.8	18
3	.3	103	27.6	27
4	.3	27	7.4	27
4	.6	68	12.1	18
4	.9	137	11.6	8
4	1.2	76	14.4	19
4	1.5	107	15.9	15
4	1.8	121	18.7	16

[1] Counts of spat on inner surface of 20 shells per bag per week (weekly bags).
[2] See text for method of computing average.

Table 4.--Setting and survival of oyster spat by station and depth, Tred Avon River and Broad Creek, Md., 1962

Station	Distance off bottom	Total of all weekly counts[1]	Average count on shells in seasonal bags[2]	Percentage survival of spat
	M.	No.	No.	No.
Tred Avon River:				
1	0.3	112	2.4	2
3	.3	283	3.5	1
6	.3	821	10.8	1
8	.3	443	4.8	1
10	.3	106	2.2	2
Broad Creek:				
1	.3	624	110.0	18
2	.3	1,392	105.4	8
3	.3	771	103.9	14
4	.3	690	59.0	9
4	.6	503	98.8	20
4	.9	808	81.0	10
4	1.2	1,025	58.6	6
4	1.5	1,262	36.5	3
4	1.8	2,096	12.7	1

[1] Counts of spat on inner surface of 20 shells per bag per week (weekly bags).
[2] See text for method of computing average.

SETTING AND SURVIVAL OF SPAT AT VARIOUS DEPTHS

Setting in the Tred Avon River at station 10 was too light to yield results on either setting intensity or survival. In Broad Creek, however, setting intensity was sufficiently heavy to permit the following evaluations. On the basis of accumulated counts on weekly bags, setting tended to be heavier in the upper 0.9 m. than in the lower 0.9 m. This difference was especially large in 1962. In contrast, percentage survival in 1962 was much higher in the lower depths (table 4).

EFFECTS OF BAGGING SHELLS

Catching spat in bags of shells was a departure from the usual practice in Maryland, where seed is collected on shell cultch broadcast loosely on the bottom; therefore, we investigated in 1962 the relation between spat yield on bagged shells and on loose bottom shells. At the end of the setting season the number of spat found averaged 9 per bag (i.e., the number of shells equal to one bag) on broadcast shells, and 29 per bag on suspended shells.

FACTORS OF SETTING AND SURVIVAL OF OYSTER SPAT

Past surveys by Federal and State biologists indicated that setting is poor in Tred Avon

River and good in Broad Creek (Beaven, 1954). These findings were supported by the counts on shells in weekly and seasonal bags. In the 2 years of monitoring, the only significant set in the Tred Avon River came during the week of 30 July to 6 August 1962. Despite this set, the final counts on seasonal bags, on the average, were less than 0.5 spat per shell. In contrast, setting was of commercial significance in Broad Creek in both years. Average counts were 1.8 spat per shell in 1961 and 7.4 in 1962 on shells in the seasonal bags.[2]

The reasons for these differences in setting intensity between the two tributaries are not known. These streams have similar salinity and temperature ranges. Some factors that could contribute to the differences are flushing rates of the two systems, circulation patterns, and abundance of brood stock.

Rates of oyster spat survival or mortality have been reported by a number of investigators. Butler (1952), who kept three separate groups of spat under observation for 13 months near Pensacola, Fla., found mortalities of 67, 33, and 22 percent at the end of that time. He reported that about 70 percent of the total mortality occurred within 4 months after setting. Loosanoff and Engle (1940) reported spat survival of 0 to 13.95 percent at various stations in Long Island Sound during the summer of 1937. Manning (1952) calculated spat survival of 37 to 62 percent after their setting in the St. Mary's River, Md. Engle (1955) estimated percentage survival of spat at Mill Hill Bar in Eastern Bay, Md. Survival rates were less than 10 percent between initial set and seed-size oysters 3 to 4 months later. Walne (1961) studied the controlled collection of spat of the European oyster in a tank. Spat transferred from the tank to natural grounds 3 weeks after setting, as well as spat kept in the tank, had a loss of about 50 percent per month the first few months after setting. At this rate the net survival was about 12 percent in 3 months. The spat survival calculated for the Tred Avon River and Broad Creek, ranging from 1 to 27 percent, closely approaches that in Long Island Sound (Loosanoff and Engle, 1940), in Eastern Bay, Chesapeake Bay (Engle, 1955), and in England (Walne, 1961).

Several explanations can be offered for difference in spat survival rates. When setting intensity is great, crowding is almost immediate, and the faster growing individuals smother those which grow slowly. When setting is light, the crowding is less severe and survival rates are higher.

Another possible explanation of different rates of survival is the influence of predation. Loosanoff and Engle (1940) calculated spat survival rates in Connecticut; they used methods essentially the same as those described here. They believed differences in survival rates between stations were due to predation by starfish (Asterias) and oyster drills (Urosalpinx). Neither of these predators occurs in the Tred Avon River and Broad Creek, but the predatory flatworm, Stylochus ellipticus, does, and this form has been found to cause oyster mortality (Loosanoff, 1956; Webster and Medford, 1961).

To date no mortalities in Broad Creek or Tred Avon River have been attributable to oyster diseases. It is, therefore, unlikely that difference in survival rates can be ascribed to this cause.

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[2] Averages derived from tables 3 and 4 with the assumption that equal numbers of oysters set on the inner and outer faces of all shells in seasonal bags.

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